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A two layer broadband antireflective coating prepared from a methyl silicone and porous silica

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Abstract

Many lasers use frequency converter crystals to obtain the shorter wavelength harmonics. Light from a typical neodymium glass laser of wavelength 1053nm, for example, can be converted to the second (527nm), third (351nm) or fourth (263nm) harmonics by passage through a potassium dihydrogen phosphate (KDP) crystal array.

Broadband AR coatings are therefore necessary for maximum efficiencies as several of the array surfaces see light of two wavelengths. This is particularly the case in high power fusion lasers where the maximum amount of energy must be delivered to the target and up to 16% can be lost from uncoated converter arrays.

A simple two layer broadband coating has been developed which consists of a first layer of a methyl silicone polymer $(CH_3SiO_{1.5})n$ overcoated with porous silica. The silicone is prepared by hydrolysis of $CH_3Si(OC_2H_5)_3$ and is applied from solution, air dried and cured at 140°. The porous silica layer is deposited at room temperature from a colloidal suspension of silica in ethanol prepared by the base catalyzed hydrolysis of ethyl silicate in ethanol.

Less than 0.5% reflection at any two successive harmonic wavelengths can be obtained on substrates of refractive index in the 1.46 to 1.51 range. The primary use to date has been on the converter crystals used in high power fusion lasers where the laser damage threshold is adequate for the fluences involved. Other non-laser uses are possible.

Key words - AR Coatings, methyl silicone coatings, porous silica coatings, sol-gel coatings.

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